Menlo Park Notebook #48 [N-79-07-05]

This notebook covers the period July 1879-July 1880. Most of the entries are by Francis Upton. Included are notes on motors and "laws of winding motors;" notes, drawings, calculations, and tests of lamps and meters; notes, drawings, and calculations about electric power distribution; and notes on experiments to determine the discharge from a magnet. There are also a few notes by Edison on filament experiments. The label on the front cover is marked "Motors & Meters" and "Upton." The book contains 273 numbered pages followed by 7 unnumbered pages.

Blank pages not filmed: 8-11, 54-55.

Missing page numbers: 17-18.

Cast Iron motors pp 113 - 139 - 141 - 179
Large machine 20.B 124/1
Meter p 233 p 103
Grains p 84
Shunts p 213

Ex periments to be made T.A.

3 Pt Iridium .005 10% to be brought up to one candle or less in the air inclos in glass and afterwards with the air exhausted.

Carbons to be sealed in 10 small glass globes and 10 very large glass globes car fully measured and diff then again measured and dipped. Each tried for the whole scale

---

July 5 1879 TAE

1

put a piece of aluminium in a porous pot with mercury. use carbon in outside cell surrounded with moistened charcoal the water with which it is moistened with ~~to contain~~ a little sulphuric acid sufficent to make it sour have its electromotive force tested =

Melt some nickel in a crucible lined with lime when moltend add 5 per its weight of aluminium

same

of ets

Cast Iron motor pp 113 - 139. 141. 179

Large machine 20. B 12

Meter p 233 p 103

Grains p 84

Shunts p 213

Experiments to be made T.A.

3 Pt Iridium .005 10% to be brought up to one candle or less in the air inclosed in glass and afterwards with the air exhausted.

Carbons to be sealed in 10 small glass globes and 10 very large glass globes care

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GENERAL ~~ELECTRIC~~.

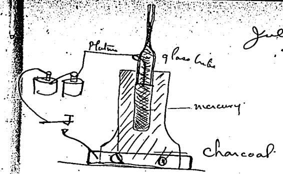
, 1896.

July 5 1879 TAE

put a piece of aluminium in a porous pot with mercury. use carbon in outside cell surrounded with moistened charcoal the water with which it is moistened with to contain a little Sulphuric acid sufficent to make it sour have its electromotive force tested =

Melt some nickel in a crucible lined with lime, when moltend add 5 per cent of its weight of aluminium make another button in the same manner adding 4 percent of its weight of magnesium —

July 5 1879
TAE


Platina
glass tube
mercury
Charcoal

Moisten the charcoal with acidulated water H_2O. SO_3. the platina wire is sealed in the glass tube & a hole made in the charcoal the hole & tube up to the Capillary bore is filled with mercury. the Idea is that on closing the Circuit the mercury will rise in the Capillary bore;

Machine:

20 inch cylinder as compared to 10 inch

Twice the outside surface

Motors

Theory

May 11, 1880.

Current to regular ·14 Ohm machine thick plates

Magnets the same of transmitter and receiver

Current passed through a depositing cell and E.M.F. measured by means of high resistance Galva. at extremities of the motor at the same time with Elec Dyno in circuit

---

No. 1 Plate 663.070

2 509.340

48.2
  2
964 revo. per minute

3 P.M TAE

High resistance galva. 260
Machine on D = 245
Elec Dyne 1° 45

Motor 964
Driving machine 1100

185
2
37.0
370
4070

16.81
4070.
11767
6724
6841670
2 H.P.

45 .16532
45 1.6532
44. .16464
4.9538

89900

Edison 991 lbs
3 58 P.M 835
156 lbs

When Prony from Motor
read: 10 lbs
5.75
15.75 at 11 feet

428 speed of Prony

15.75 1.1973
11 1.0414
428 2.6314
74.200 4.8701

156000 5.1931
1.6770

47%

3-45 H.R. 362

10 lbs Prony

150 H.R.

346 Started Machine

19° 45°

3 50 147 H.R

1/2 minute Prony

188

2

376 Crosby

3-36 135

230 revo Prony
probably 330 Crosby

3-51 or 3-52 10 lbs on Prony

---

500 revo Motor 1/2 minute
322 dyne

500 2.6990
322 2.5079

1.55 .1911

.011363 Grammes Ag
Everett C.G.S.

19010

134.5 2.1287
19010 4.2790
$\bar{3}.8497$
60 $\bar{3}.4782$
$\bar{1}.6279$

216 : 134.5 :: .011363 :

2.1287
Comp 7.6655
$\bar{2}.6554$
60 1.7782
$\bar{1}.6278$ = log .424

P. ~~$c = A \sin^2 x$~~

$c^2 : c'^2 :: \sin c : \sin c'$

$c^2 = \sin c \dfrac{c'^2}{\sin c'}$

$\sin c = \dfrac{\sin c'}{c'^2} \dfrac{c^2}{\quad}$ $c' = 1$

$c : c' :: \sqrt{\sin c} : \sqrt{\sin c'}$

$c = \dfrac{\sqrt{\sin c}}{\sqrt{0 \sin c'}}$ $\sqrt{\sin c'} = \dfrac{\sqrt{\sin c}}{c}$

Plates
No. 1 659.180
No. 2 513.210
May 12 1880

No 1 646.270
2 512.825

a.m
10-5 Started
1° 30' Elec Dy
1° 22'
10-14 Stopped

N.G. Found a piece of wire in bottom of vessel

644.230 639.170
514.500 519.710
1158.730 1158.880

644.230 519.710
639.170 514.500
5.060 5.210
5.210
10 270
5.135 0.7105

comp. 15 8.8239
comp .0195 11.7100

17.56 Nelson 1.2444

sin 3° 58' 2 | 8.8400
4.4200
1.2444

Constant Q.D. 3.1756

/

Plate 1 644.230
Plate 2 514.500

10-56	4° Started
10 58	4°
11—	4°
	3° 58'
	3 50' Stoppe
11-11 10.56 15	Good zero
Plate 1	639.170
2	519.710
	Plate

12° 10'

9.3238

4.6619

3.1756

30.6 Webers 1.4863

$\frac{179}{3} = 59.6$ 1.7752

1.6464

4.9079

80.900

$c = \frac{E}{R}$

$c^2 R = CE$

10.75 1.0315

436 2.6395

11 1.0414

4.7124

51.500 ft lbs

436 2.6395

11 1.0414

10.75 1.0315

4.7724

51.500

2.6395

.1911

~~Motor~~

677 revs 2.8306

30 270 on H.R.

Correction

H.R. 3 to left when the Prony was taking 10 lbs at 8

64.5 to 69 with 10 lbs at 11 feet

2.3

48 Started

5 lbs at 11

182 L H.R.

12° 10'

1 50 .180.

12° 10'

637.880
522.380
1160.260

1-51 436 revs

160 H.R

1-47'-30" Stopped

Leading wires hot
machine cool

Cu. Plates gave
blackpowder

Plate I: 637.880
Plate II: 522.380

15.75 1.1973
441 2.6446
11 1.0414
76.400 4.8831

3 | 195
65-1=64 | 1.8062

23° 37 2 | 9.6027
4.8013
3.1756
42 Webers 1.6257
1.8062
1.6464
119.000 5.0783

4.8851
5.0783
1̄.8068
Cu. 64%
Bradley 59.7% .0308
1.7760
3
5 07830
128000 .0308
5.1091

1.6257
.13 1̄.1139
.7396
5.91 Volts
64
~~5.5~~
5.915 volts
opposing

3.1756
3.1448
.0308

2-15 Started

10

.200 H. R

448 Revs

23° 30'

195 H, R

23° 45

195 H, R

435 revs

10 lbs

448 2.6513

.1911

696 2.8424

comp 1100 6.9586

696 2.8426

89 1.9494

56.3 Volts 1.7506

89

56.3

Whole Arm 32.7 Active

1.5145

1.514.5

1.6464

.2218

78000 4.8972

From a field

56.3 opposing

From current.

59.5 Opposing

56.3

59.5

= 115.8

57.9

7½ lbs at 11

$\frac{270}{3}$ Volts

$\frac{215}{71.6}$ HR

17° 2′

215 H.R.

489 Revs

89 2.6893

12.75 1.1055

11 1.0414

4.8362

8.600 5.0919

5.5% $\bar{1}$.7443

17° 2′ 2)9.4668

4.7334

3.1448

38.7 Webers 1.5886

71.6 Volts 1.8549

1.6464

123000 ft.lbs. 5.0919

489 2.6893
.1911
76.0 2.8804

comp 1.100 6.9586
2.8804
1.9494
Speed 61.4 Volts 1.7884

38.7 1.5886
Cold .13 $\bar{1}$.1139
50.4 1.8025

70.6
5.04
Current 65.54 Volts

7½ lbs 2nd time

170 – 260 H.R

17°

160 – 270

270
160
430
215

17°-25

495 revs

19°

210 HR

482

215

270 H.R

7½ lbs

44 | 18° 45′

170 – 25 U
475 revs

49 | 17° 12

2-50 | 18° 35′ 468
205 on H. R.

2-51 | 18° 10′
205 H. R
17.

Zero 20′ R
to be added.

Page 34

~~89.~~
~~57.9~~
~~31.1~~

~~1.4928~~
~~1.4928~~
~~1.16464~~
~~10.7959~~
~~5.4279~~

~~.16~~

~~267000~~

71.6
59.5
121

1.0828
1.0828
1.16464
10.7959
4.6079

40.500

59.5 1.7745
121 8.9172
5.2996

199.000

The Prony set at 5 lbs and changed as follows without touching

5 1/2 14° 35

6

6 1/2 16°

7 19°

5 minutes about.

5 lbs.

3-45

3 44-30" 225

10° 5'

10. 30' 517 two

225 H.R.

3-46 12°

3-46-30 12° 15'

222 = D H.R.

504

Zero grade

637.880
522.200
1160080

522.200
519.140
3.060
1.630
1.430

637.680
519.140
1156820
1160.080
2/3.260
1.630
50
1.580

1.580 0.1987
comp .0195 1.7100
comp 5. 9.3010
16.2 Webers 1.2.09.7 from Cu cell

2/9.3088
4.6544
3.1448
32.3 Webers. 1.5096

637.880
637.680
.160

Plate 1 637.880
Plate 2 522.200 H_2SO_4 in solution

5 lbs

4-0'-30"	Started
	11° 32'
	195 H.R.
	550 revo
4-2'-45"	12° 10'
	190 H.R
	539 revo
4-3'-15"	11-52'
	185 H.R
4-4'-45"	160
4-5'-30"	325 3/4 minute

Plate 1 637.680
2 519.140

Arranged so as to
throw ·25 Ohm into line

4-18"	12°-30'	·25 in
	12°-50'	·25 out
	no change of 5 lbs.	
4-20"	12°-45	·25 in
4 22"	14°.10'	·25 out
	498	
4-23"	13°	·25 in
	472	
	1.90 H R	

48

6.75 0.8293
1.1 1.0414
671 2.8267
49,800 4.6974

11° 20 2)9.2934
4.6467
3.1448
31.7 Webers 1.5019
65.6 Volts 1.8169
1.6464
92.300 4.9652

4.6974
4.9652
.7322
54% .31.7

49

Shunted the magnet of the motor . with 1½ Ohms

260

1 lb on Prony 11 feet

200 H, R

2 minute 11° Elec

671. Revs

11° 20

195 .25 Ohm in line

652 revs

198/60

80- 1579 1.89976.
3.9 0.5911 4.2
20.12 Webers 1.3065

2) 8.9026
4.4513
1.3065
3.1448

Through
5 of 4 boxes each + E.D

4° 35' Elec Dyne

---

240 H.R. 3.9 Ohms

245 H.R around boxes

3 L

Results

Prony 47% of Edison
74,200 ft lbs out of 156000 ft lbs

---

10 lbs 448 rev

119.000	Cu	64%
128000	Bradley	59.7%
76.400	Prony	

123.000	Bradley	55.5%
68.600	Prony	

Magnet shunted

92.300	Bradley	54%
49.800	Prony	

May 14

Plate 1 630.300
2 512.770

freshly cleaned

To try motor with a meter

8–11 Ohms in spool
around .1 and .12 shunt
of very large wire

Plate 11 36.990
12 37.0575
13 40.3563
14 36.751

151.1548
151.4457

0.091

a-m

8-45 Plates put in the solutions

9-35 65R = D from 20 cells
65L = " "
with current on line

E.M.F 155 — 170 R
153 — 1 L

5° 30' Elec Dyne.

112 - 118.5 = D

9-45 5° 25'

111 - 122 = D
on 1.98 ohms

115 - 125 when first put on

42

11 36.990 ✓
36.877 ✓
.113

37.0575 ✓
12 36.916 ✓
.1415

13 40.4642 ✓
40.3563 ✓
.1079

14 36.~~88~~5 ✓
36.751 ✓
.1373

.1415
.1375 12 & 14
.2790
.1395

.113
.1079 11 & 13
.2209
.1104

11.976 1.0780
.1395 $\bar{1}.1446$ 12 & 14
85.8 Ratio 1.9334

11.976 1.0780
.1104 $\bar{1}.0429$
108 Ratio 2.0351 11 & 13

a.m.
9-53 Started

54 109-119
5°-7'

Temp battery 60° F
Depository 62' F

20 cell 347
Battery 4 days old
~~8~~ cells 334 R

.80 = D around 10-11

10-16 in with plates 12 & 14

114.5
2 | 38.2
19.1 Webers from resistance

2 | 8.9403
4.4701
19.1 1.2810
3.1891

112
2 | 37.3
18.7

8.8914
4.4457
1.2430
3.2027

May 14

10-8 4° 44'

10-8 334 R 8 cells
60 R

Zero 16 R

10-10 4° 30'

10-12 74 on 10.8 Ohm
plates 12 b 14

10-14 5°
20 cells 655

10-15 Elec dyne 5°
108.4 116 HR.

$$\frac{246}{4 \times 1.079}$$

2.3909
9.3979
9.9678
57 1.7558

8.2442
115.5 2.0626
2.02 Volt .3068
10.8 −1.6334
$\bar{1}.2734$

.187 Weber $\bar{1}.2734$
37 1.5682
19.5 1.2900
135 2.1316

May 14

10-16 5° 4′

10-17 108 − 119 HR

10-19 5° 4

110 − 119

~~4 cells~~

10-20 5° 4′

4 cells = 247 R

D around 10.8 Ohm

in with Rote 12 & 14

112 − 121

114.5 ; 23 :: 2 : x

2

46 1.6628

114.5 2.0588

$\bar{1}$.6040

.4 Ohm resistance of large depositing cell

.an 167

1165 ; 167 :: 10.8 : x

1.0334

2.2227

$\bar{1}$.9336

1.2877

19.4

10.8

8.6 ohms the two about

May 14

-23 around 10.8 and two depositing cell

160 - 174 R

10-24 5° 4'

10-25 94 - 87 L

95 - 88. around 10.7 ohms

10-27 5° 4'

20 cells 65 R

10-28 D. around depositing cell

23

10-29 110 - 117 around 2 Ohms

5° 10'

.0648
4.5

.291

648
.648
.7128

$\bar{2}.8116$
0.6532
$\bar{1}.4648$

$\bar{2}.8116$

630.300
512.770
1143.070
1139.004
4.066

630.300
616.291
14.009

522.713
512.770
9.943
14.009
23.952
11.976

11976 4.0780
comp 35 8.4559
comp 19.5 8.7100
1.2439

17.5 Webers

9 53
10–30
37

May 14

Stopped

Zero E.D gaud

Plate 1 616 grammes 4.5 grams
2 526 grammes 11 grams

— 616.291 cut ends off plates
522.713
1139004

Plate 11 36.877
12 36.916
13 40.464 $\dot{2}$
14 36.8885
151.1457

May 14 Results

19.1 Webers calculating from the resistance

17.5 Webers calculating from the Cu. deposited on the plates in the main line

The plates on the shunts took $\frac{1}{88.8}$ & $\frac{1}{108}$ of the current circulating

---

May 14
Motor running free

939 Motor revs.
633 Prony revs.
940 Motor revs.

1° 50'
157 H.R

1.5

11-50 260 H.R TAE

12.5 lbs at 11 feet on Prony

165 H.R

189 revo.

34°

1ft.11 inches Radius

46 in diameter

144

15.06

30.12 96

Prony right

.0648

$\bar{1}$.8116
0.6532
$\bar{1}$4648

.291

.0648
.1944
0648
.2592
.1296
.3888
.0648
.4536

541.291
460.194
1001485

447.032
480.389
927421

442.259
469.453
911.712

May 15

Standard cells

185 R 190 L
184 R 189 L
184 R Very good
185 R
185 R

11. A.M.

No. 1 541 grammes 4.5 grains
2 460.194 3
3 447.032 .5
4 480.389 7
5 442.259 4.
6 469.453 8.
7

2

19.830
19.7805
.0495 loss

14.322
14.287
.0350 gain
.0072
.0422

9.761 .9894
.10422 $\bar{2}$.6253
232 2.3641

1

20.1467
20.097
.0497
.0335
2) .0832
.0416 234

.9894
$\bar{2}$.6191
2.3703

May 15

Lawson Meters
Cu. sulphate with H_2SO_4

1
18.8605
20.1467
39.0072

.05 Ohm shunt

TAE

2
19.830
14.287
34.117

.05 Ohm Shunt

1
18.894
20.097
39.991

18.894
18.8605
.0335
.0081
.0416

2
19.7805
14.322
34.1025

39.0072
39.991
2) .0162
.0081

34.117
34.1025
2) .0145
.0072

P.M. May 15

1-57 Started TAE

Plates 5 & 6
in main current

Plates 1 & 2
H_2SO_4 & $CuSO_3$
Plate 3 & 4
in saturated Cu

2° 2' 2° 30'

80 & 84 on 1.95 Ohms

2° 9' 2° 38'

2-32 Stopped

.06~~4~~8
9.5
.615

$\bar{2}$.8116
.9777
$\bar{1}$.7893

$\bar{2}$.8116
.1761
$\bar{2}$.4877

13

$\bar{2}$.8116
1.1129
.9255

.0648
5
3240
648
3888

.542
648
.7872

(1,2) 535.615
465.842
1001.457
1011.485
(.028
.014

(3,4) 451.097
476.324
927.421
0

(5,6) 451.787
459.389
911.176
911.712
(.536
1268

(1) 541.291
535.615
5.676

(3) 451.097
447.032
4.065

(5) 451.787
442.259
9.528

(2) 465.842
460.194
5.648
.014
5.662
4.065
9.727

(4) 480.389
476.324
4.065

(6) 469.453
459.389
10.064
.268
9.796
9.727
.069

9.796
9.727
9|19.523
9761

May 15.

		Grammes	
Plate	1	535.615	9.5 grains
	2	465.842	13.
	3	451.097	1.5
	4	476.324	5.
	5	451.787	12.
	6	459.389	6.

TKE

11	36.972
12	36.840
13	40.3747
14	36.970
	151.1567

12 36.916
36.840
.076

11 36.972
36.877
.095

14 36.970
36.8883
.0815
.076
2 (.1575
.0787

13 40.4642
40.3747
.0895
.095
(.1845
.0922

9.806 0.9912
.0787 $\bar{2}$.8960
124. 2.0952

9.806 0.9912
.10922 $\bar{2}$.9647
106 2.0265

17 Webers
86.8 Ratio 106. Webers
1.08. Ratio 124.

86.8 : 106 :: 108
2.0265
2.0334
8.6615
132 — 2.7214

May 15

9.806 0.9912
comp 35 8.4559
comp 19.5 8.7100
8.1571
3.
14.3 Webers 1.1571

2/.0648

.5 .0324
.0324
1 .0648
.0324
1.5 .0972
.0324
2 .1296
.0324
2.5 .1620
.0324
3 .1944
.0324
3.5 .2268
.0324
4 .2592
.0324
4.5 .2916
.6324
5 .3240
.0324
5.5 .3564
.0324
6 .3888
.0324
6.5 .4212
6324
7 .4536
6324
7.5 .4860
.0324
8 .5184
.0324
8.5 .5508
.0324
.5832

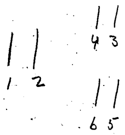
.5822
.0324
9.5 6156
6324
10 .6480
0324
10.5 6804
.0324
11 7128
0324
11.5 7452
324
12 7776
324
12.5 8100
324
13 8424
324
13.5 8748
324
14. 9072
324
14.5 9396
324
15 9720
324
10.044

Monday May 17 1880

Meter experiments
Large plates with bending post

No.	Grammes	
1.	509.940	14.5 grains
2.	436.	
3.	433.842	13.
4.	447.713	11.
5.	435.842	13.
6.	441.778	12.

TAE



Plates 9.5" X 5.5"

9.5
5.5
52.2 sq.in.

$$\begin{array}{r} .9777 \\ .7404 \\ \hline 1.7181 \end{array}$$

May 17

2-17 Started

2-19 5° 48′

2-22 125 on H.R around 2 ohms+
240 Total ?

2-27 5° 30′

2-31 4° 45′
118 on H.R

2-33 5°

2-55 4° 45

2-59 120 — 114 Left H.R.
3-2 Stopped 3° 45′
D = 125 - 100

After

492.324 ✓
452.486 ✓
944.810

509.940 ✓
492.324 ✓
17.616
.565
17.051 Loss

Before

509.940 ✓
436. ✓
946 940
944.810
1.130
.565 ✓

442.810 ✓
438.130 ✓
880.940 ✓

442.810 ✓
433.842 ✓
8.968
307 ✓
9.275 ✓ gain

433.842 ✓
447.713 ✓
881.555 ✓
880.940 ✓
2) 615
307 ✓

443.907 ✓
433.097 ✓
877.004 ✓

443.907 ✓
435.842 ✓
8.065
308
8.373 ✓ gain
9.275 ✓
17.648 ✓

435.842 ✓
441.778 ✓
877.620 ✓
.604
.616
308 ✓

May 17

Plates	Grammes	grains
1	492.324	.5
2	452.486	7.5
3	442.810	12.5
4	438.130	2.
5	443.907	14.
6	433.097	1.5

11	37.122
12	36.6675
13	40.231
14	37.468

Lamm's plates put the
the wrong way to the current

17.648 1.2492
cmts .0195 11.7100
comp 45. 8 3468
202 Weber 1.3060

(11&13)
37.122
40.231
77.353
77.3467
.0063 .0031

(11&12)
36.972
40.3747
77.3467

37.122
36.972
.150
003
.153

(12&14)
36.6675
37.1468
73.8143
810
.0043
.0021

(12&14)
36.840
36.970
73.810

36.840
36.6675
.1725
.0021
.1746

17.648 1.2492
.153 T.1847
(11&13) 116 . 2.0645

1.2492
.1746 T.2420
2.0072
(12&14) 10.1

May 17 TAE

Strip of German silver
w.c. .009 in thick 1/4 in wide
3' 10" long .2 Ohm resistance

4 | 46" long
11.5 long .05 Ohm

1/2 inch wide 1 foot long
.025 Ohm
1 inch wide 2 feet long

May 17 Results

430.930
383.777
814707
813.501
1.206
.603

435.077
381.065
816.142
815.777
2 .365
.182

396.609
425.706
822315
821.971
.344
.172

402.886
410.615
813501

430.930
402.886
28.144
.603
27.541

423.583
392.194
815777

435.077
423.583
11.494
.182
11.312

412.842
409.129
821971

425.706
409.129
16.577
.172
16405
11.312
27.715

May 18

Plate	Grammes	Grains
1	430.930.	14.4
2	383.777	12.
3	435.077	1.2
4	381.065	1.
5	396.609	9.4
6	425.706	11.4
1	402.886	13.7
2	410.615	9.5
3	423.583	9
4	392.194	3
5	412.842	13
6	409.129	2

(1)
20.1613
20.012
.1493
.0132
.1361

38.6835
38.657
.0265
.0132

(2)
19.8478
19.7105
.1373
.0136
.1237

33.7943
33.7670
2).0273
.0136

(3)
16.819
16.7022
.1168
.0066
.1234

33.8482
33.835
.0132
.0066

(5)
18.4005
18.273
.1275
.0074
.1349

38.6703
38.6555
.0148
.0074

Lawson's plates
Cu Shunt .05 Ohm

1
20.1613 ✓
18.5222 ✓
38.6835 ✓

20.012
18.645
38.657

2
19.8478 ✓
13.9465 ✓
33.7943 ✓

19.7105
14.0565
33.7670

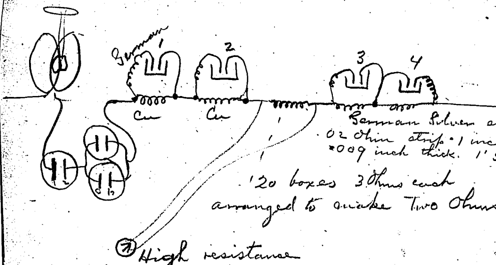
3
16.7022 ✓
17.146 ✓
33.8482 ✓

16.819
17.016
33.835

4
18.273 ✓
20.3973 ✓
38.6703 ✓

18.4005
20.255
38.6555

Remarks Nos 1 & 2 corroded a little
All in Cu. sulphate commercial with $\frac{1}{15}$ of sulphuric acid.
Plates placed in solution 9 a.m
Taken out at 5 P.M
Temp 70°F


German
1
2
3
4
Cu
Cu
7

German Silver shunt
.02 Ohm strip .1 inch wide
.009 inch thick. 1' 5.5"

120 boxes 3 Ohms each
arranged to make Two Ohms

High resistance

TAE

May 18

4-1	Started
4-5	5° - 20'
4-28	6°
	6°
	130 on 2 ohms
5-6	5-0 5-5-1
5-9	Stopped

27.715
27514
1201
1.00
27514
27.624   1.4412
.1361 $\bar{1}.1338$
(1) 203   2.3074

1.4412
.1237 $\bar{1}.0920$
(2) 223   2.3492

page 213 for shunt

(3) $\frac{1}{223}$ 1.4412

1.4412
(4) $\frac{1}{204}$ .1349 $\bar{1}.1300$
2.3112

May 18 Results

Deposited in One cell   Two cells by Webers

Page 80   9.796   99.7.27
17.051   17.648

Page 94   27.541   27.715
54.388   55.090
54.388
.702

.702 $\bar{1}.8463$
54.3   1.7348
$\bar{2}.1115$

. 1.3% difference

page 104   54.388   55.090
15.528   14.985
69.916   70.075
69.916
.159

.159 $\bar{1}.2014$
70.0 $\bar{2}.8451$
$\bar{3}.3563$

0.22 % difference
all results

417.642
394.295 (1+2)
811.937

813.501
811.937
2 | 1.564
.782 loss

415.194
400.324 (2+3)
815.518

4 815.777
815.518
2 | 1.259
.129 loss

406.180
415.917 (3+4)
822.097

822.097
821.971
| .126
.063 gain

410.615
394.295
16.310
.782
15.528

15.528
14.985
| .543
.271

423.583
415.194
8.389
.129
8.260

8.260
6.725
14985
.271
15256

412.842
406.180
6.662
.063
6.725

Page 103

May 19

Current from one bichromate cell passed through system

10 hours

	Grammes	Grains
1	417.642	10.9
2	394.295	4.4
3	415.194	3.
4	400.324	5.
5	406.180	2.7
6	415.917	14.2

15.256
Comps 600
19.5

1.3 Webers

4.1832
7.2218
8.7100
.1150

(1)
20.0123
19.8223
.1897
.0103
.1794

Wrong

(2)
~~19.7105~~
19.649
.0615
0088
.0527

14.1003
14.0565
.0438

(3)
16851
16.819
.032

17.016
16.9725
.0435
.0057
.0378

(4)
18.4308
18.4005
.0303

20.255
20.2107
.0443
.007
.0373

Lawson's plates

TOl

1
18.814
19.8223
38 6363

38.657
38.6363
2|.0207
.0103

2
14.1003
19.649
33.7493

33.7670
33.7493
2|0177
.0088

3
16.851
16.9725
33.8235

33.835
33.8235
2|.0115
.0057

4
20.2107
18.4308
38.6415

38.6555
38.6415
2|.0140
.007

15256
.794
(1) $\frac{1}{84}$
Bad connection in shunt
1.1832
$\bar{1}$,2539
1.9293

---

(2) $\frac{1}{280}$ .0527
1,1832
$\bar{2}$.7218
2.4614

---

(3) $\frac{1}{476}$ .032
1,1832
$\bar{2}$.5051
2.6781

---

(4) $\frac{1}{503}$ .0303
1,1832
$\bar{2}$.4814
2.7018

503
476
2)979
489

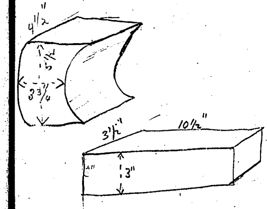
$\frac{1}{489}$ Page 212

May. 19

Small cast iron motor

Dimensions TAE

Magnet 3" diameter
18" long


4 1/2"
5 1/2
3 3/4
3 1/2"
10 1/2"
3"

4.85

7.06 0.8488
36 1.5563
.26 $\bar{1}.4150$
66.1 lbs 1.8201

10.5 1.0212
10.5 1.0212
.26 $\bar{1}.4150$
28.6 1.4574
66.1
94.7 lbs iron in magnets

4.96
2.5

19.32
4.91
14.41 1.1587
4.156 0 6190
.26 $\bar{1}.4150$
17.1 1.2327

$\frac{1698}{} \times \frac{\text{Volts}}{6.8}$ = efficiency current on magnet

3.2299
0.8325
2.3974

May 19 Cast iron motor

Armature 0"0.14 plates

0"001 of tissue paper between them.

Wooden core 2"5 diameter

Iron outside 4".96 "

Length Thin plates 4".44

Total length iron 4".56

Magnet wound with 3 layers 0".049 wt. 10 lb.

Resistance 6.8 Ohms

One magnet arm 283 turns in each layer X6=1698 turns Total both sides

Armature 37 coils each wound with two wires of three turns

Old machine

magnet 28. 1.4472
72 1.8573
.28 $\bar{1}$.4472

564 lbs 2.7517

42 1.6232
21.5 1.3324
.28 $\bar{1}$.4472

253 lbs 2.4028
564

717 lbs of iron magnet

May 19

TAE

1640 revs. 25 Volts on field magnet 6.8 Ohms
16.6 Volts from armature
.17 Ohm internal resist

Old machine 1100 revs
120 Volts could be obtained
and used 9 inches face
75 coils X 2 turns = 150 turns

150 120 2.0792
9 1350 3.1303
1350 $\bar{2}$.9489

.0889 Volts per inch

log $\frac{1}{1350}$ = 6.8697
constant of old machine to reduce to volts per inch

25 1.3979
1.3979
comp 6.8 1.6464
9.1675

3.6097

4080

Old regular 10"

.75 $\bar{1}$.8751
3.14 0.4969
1100 3.0414

3.4134

2590 feet per minute at 1100 revs.

2500 3.3979
2590 3.4134

$\bar{1}$.9845

to reduce to surface speed of 2500 from 1100

$\bar{2}$.9489
$\bar{1}$.9845

.0858 $\bar{2}$.9334

May 19

Cast Iron machine

37 coils 3 turns = 111 turns
4.5 inches

16.6 1.2201
comp 111 7.9547
comp 4.5 9.3468

$\bar{2}$.5216

.0332 volts per inch 1640 revs

$\bar{2}$.5216
½ size 2200 3.3424
comp 1640 6.7852

.0446 8.6492

.0446
2

.0892

That is with the same surface speed the cast iron machine of ½ dimensions gives ½ the E.M.F. per inch of wire wound on it.

8.6492
Page 116: $\bar{1}$.9845

$\bar{2}$.6337

.043

2500 feet per minute .043 Volts per inch

37 commutators
3
111 turns
45
555
444
4995 inches of wire
2 as rewound page 241
9990 inches of wire

34
7.1

Regular 10"

2X75 = 150 turns
150
9
1350 inches of wire

20" 2X75 = 75 turns
75
9
675 inches of wire

May 19 –

If magnet cast iron machine were wound with No. 10 wire three layers it would have one fourth the resistance of the regular machine

4)1.51
.37

Multiple arc the sides and each layer will give $\frac{1}{36}$ of this or about .01 Ohm

If armature be wound with one turn it will give $\frac{1}{9}$ of present resistance or about .02 Ohm the machine would have 5 Volts E.M.F and a resistance of .03 Ohm which would make an

Magnets Cast iron 4.5"

p113 .1698 3.2299

comps 6.8 .8325

2.3964

Constant to X Volts by

20'

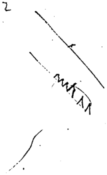
2 | 1752

876. 2.9425

May 19

excellent plating machine

c .02



May 19

Make meters two of each kind

coil with meter Shunt
5 Ohm .005

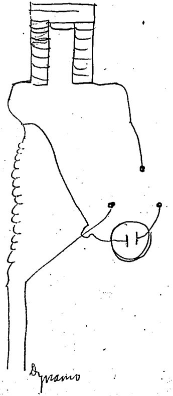
Strip German silver
2' 6" by 6"

5 Ohms .001

strip 2' 6" by 3"

5 Ohm strip 3' by 2"
5 Ohms strip 3' by 1" .04
10 Ohms " 3' by 1/2" .08
10 Ohms 6" by 1/4" .32
20 Ohms 12' by 1/4" .64

To determine the amount of discharge from a magnet



page 133

404.318
406.259
810.577

417.642
404.318
13.324
1.360
17.964

811.937
810.577
1.360
.680

406.259
394.295
11.964
.680
12.644

May 20 Meter

Large plates current of two cells
for 6 hours yesterday May 19
No. 1 404.318 4.9
2 406.259 4.

See page 105 TAE

38.6363
38.6254
2 | .0109
.0054

19.0292
18.814
.2152

33.7493
33.7355
2 | .0138
.0069

19.649
19.597
.052
.0069
.0589

33.8235
33.8125
.0110
.0055

16.9305
16.851
.0795
0055
.0740

38.6415
38.4782
2 | .1633
108.16

20.2107
20.0167
.1940
.0816
.1124
.0740
(0.1864
.0932

May 20. Meter.

Lawson's plates Page 107

1. 19.0292
19.5962
38.6254

New handle
19.0278

2 19.597
14.1385
33.7355

3 16.9305
16.882
33.8125

16.882
16.851
.031

16.9725
16.9305
.0420

4 20.0167
18.4615
38.4782

May 20 Meter

12.644 4.1018
215.2 2.3328
58.7 1.7690

4.1018
589

4.1018

4.1018

12644 4.1018
1 .0932 1.9694
135 2.1324

May 20 Discharge
of magnets page 125

Resistance magnet 1.4 Ohms

6 | 33000

5500 3.7404

44.3 8.3536

1.4 .1461

2 | 2.2401

1.1200

13 Volts

$ft\ lbs = \frac{V^2}{R} \times 44.3$

$V^2 = \frac{R\ ft.lbs.}{44.3}$

8.5 1.9294

1.3 1.1200

.8094

.1461

9 Ohms .9555

Large Magnet 1.94 Ohms

$\sqrt{2} = 1.41$ $\overline{)3010}$ .1505

Magnet 4 per H. P.

4 $\overline{)33000}$
8250 3.9165
1.94 0.2876
Comp .443 8.3536
$\overline{)\underline{2}.5577}$
1.2788
19

19 Volts on magnet.

page 197

May 20

Plate No 5		405. x	14.5
	6	415	7.7

Wrong connection made so that main current run through plates

---

Plate No. 5		405	10.4
	6	415	10.5

Started 10-36

break every minute

Cross found in wires to galva.

Plat. 5	405.	10.4
	415.	9.5
50 Times	405	6.7
	415	10.9

23
page 112
5740

1.3617
2.3974
3.7591

21.5
5350

1,3324
2.3974
3.7298

21
5240

1,3222
2.3974
3.7196

19.5
4860

1.2960
2.3974
3.6874

17.1
4270

1,2330
2.3974
3.6304

14.7
3670

1.1673
2,3974
3.5647

May 21

Resistance 6.8 Ohms
cast iron machine
10 = 1 Volt speed 1600

E. M. F on Magnet Armature

23.0 Volts 15.8
215 15.5 31
14.4 28.8

Belt tightened
1640 - 1660 revs

21. Volts 15 Volts
19.5 14.5
1620 revs 17.1 14.5 Volts 29
14.3

Current broken on magnets same resistance as before

10-40 C.B. 13.8 Volts
17.1
13.3 26.6
14.7 CB 13. 26

On magnet		Armature	
12.3	CB	12.3 12.3	24.6
11.9		11.9	23.8
11.3	C.B	11.9 11.8	23.7
		11.0	22
8.5	O.B	10.7 10.4	21.4 20.8
		9.5	19
5.35	C.B	8.7	17.4

50. Permanent
Brought up

21.5	15 Volts	30
25 Volts	15.6	31.2
29.2 Volts	16.9	33.8
	17 Volts	34
29.2 25 Volts	16.5 volts	33

```
  1254
     2
  ----
  2408
     4
  ----
  9632
   1.5
  ----
 48160
 9632
 ---------
1.444.800  ft lbs
```

1

```
  918
   16
  ----
 55.08
 918
 -----
14.688
```

```
 918
   2
 ----
1836
```

May 21

Cast iron motor

1254 revs 1/2 minute

1 lb. 8oz. at 4 ft

918

2 lbs at 4 ft

at 46 Volts

2408 revs per minute

14,448 ft lbs

1836 revs

14.6886 ft lbs

probably too high as I had take two lbs. as a round

The motor put with 80 Volts the centrifugal force burst the brass wire

404.328
357.518
46.870 loss
.76
46.11

450.454
405.382
45.072 gain
.76
45.81

May 21

Plate	~~Meters~~ Grammes	grains
1	404.328	4.9
2	406.238	3.7
5	405.382	5.9
6	415.8100	12 5
	1631.758	
After	Grammes	grains
1	357.518	8.
2	451.486	7.5
5	450.454	7.
6	369.259	4
	1628.717	

1631.758
1628.717
4) 3.041
.76

19.1592
19.0278
.1314 gain
.0411
.1728

19.597
19.394
.203 loss
.0357
.1673

17.0335
16.9305
.1030 gain
.0465
.1495

20.0167
19.843
.1737 loss
.0336
.1401

May 21
Niter

192
384

Lawson's plates in two sets

after	before	
19.1592 19.3825 38.5417	19.0278 19.5962 38.6240 38.5417 .0823 .0411	(1)
19.394 14.270 33.664	19.597 14.1385 33.7355 33.664 2 .0715 .03557	(2)
17.0335 16.686 33.7195	16.9305 16.882 33.8125 33.7195 .0930 .0465	(3)
19.843 18.568 38.411	20.0167 18.4615 38.4782 38.411 .0672 .0336	(4)

In the solution about 24 hours.

3 lbs coal 0.4771

2240 in Ton 6,6498

$ 4.50 2.6532

$\bar{1}.7801$

.6 cts per hour for coal

8 lights

.075 ct per lamp per hour

5 cu. ft

$\frac{1}{200}$ of 1000 ft at

.5 ct per hour

$1.00 per 1000 cu. ft.

95 : 119 :: 85.5

1.9320
2.0755
8.0223

2.0298

107 Ohms

80

1.9031
1.9031
1.6464
7.9702

3.4228

2650

Lamps Bast fibre

8 May 22

Resistance of line 85.1 Ohms

Lamp 1095

R. cold .153 Ohms

9-55

240 on H.R

95 on L.R

7.5 candles

119 on resistance 85.1

240 on H.R

115 ; 133 :: 85.1

85.1	1.9299
133	2. 1239
amps 115	7. 9393
	1.9931

98.4 Ohms

3)260

86.6	1.9375
86.6	1.9375
44.3	1.6464
amps 98.4	8.0069
	3.5283
3370	4.5185
	99.02

9.8 per H.P.

15 candles

10-15

260 H.R

115 L.R

133 on 85.1 Ohms

258 H.R

1085	JM 1083	candles
2650	2620	7½
3370	3380	15
4160	4225	30

2650
883
3433

(2620
873
3493

(2650
66.2
3312

4(3370
8.42
4212

133.5 : 145 :: 86.5

1.9370
2.1614
7.8745

94 ohms 1.9729

3)282
94

1.9731
1.9731
1.6464
8.0271

4160 3.6197

---

30 candles

10-30 282 H.R
133.5 L.R
145 on ~~85.1~~ 86.5 Ohms

30 candles

10-40 281 H.R
133 L.R
145 on ~~85.1~~ 86.5 Ohms

104 : 120 :: 86

1,9345
2.0792
7.9830
1.9967

99.2

3 (230
76.6

1.8842
1.8842
1.6464
8.0033
3.4181

2620

1083 May 22

R = 145 Perfect carbon

7.5 candles

10-48 230 H.R
103 L.R

7.5 candles

239
105 L.R
120 on ~~85.~~ Ohms
86. Ohms

117 : 132.5 :: 88.

88 1.9445
132.5 2.1222
117 7.9318
1.9985

99.6 Ohms

3) 251.5
87.2

1.9405
1.9405
1.6464
8.0015
3.5289
3380
4.5185
9.76 per H.R .9896

No. 1083 May 22

15 candles

251.5 H.R
117 L.R.
132-33 on 85.1 Ohms

15 candles again

11-10 253 H.R
119 L.R
133 on 85.1

136.5 : 142 :: 86.5 —

1.9370
2.1523
7.8649
1.9542

90 Ohms

.3

275
91.6

1.9619
1.9619
1.6464
8.0458
3.6160

4130

4)3380
845
4225

4130
3380
750)33000(44
3000
300

Lamps No. 1083 1083 May 22

30 candles

275 H.R
137-36 L.R
11-25
142 in ~~85.1~~ Ohms
86.5

2620
3380
4225

1/3)2680
873
3493

7 1/2 Average — 30
15

2620
2650
)5270
2635

4160
4225
)8385
4192
3375
817

3375
2635
740

2685 3.4288
740 2.8692
.5596

3375 3.5282
817 2.9122
.6160

3.56

4.15

Page 200 paper lamps

mp no. 1094 May 22

R 123 Ohms cold
perfect carbon.

15 candles ?

.240 H.R

11-30 127 on 8511 Ohms

No 1093 May 22

R 145

Perfect carbon

13 candles

223 H. R

123 L. R.

15 candles Edge 14 candles

230 H. R

123 L. R

11-55

Resistance 92 Ohms ?

1118
255.454

862.546
.0022

1725092
172509

1.897599

1.9 lbs of H_2O

25.54
.0022

5108
5108

.056188
1.9

1.96 lbs H_2O

May 22

Calorimiter test New Mould Paper

Total Wt of Calor

grammes
203 5.8 grains

Wt of vessel 168. 7 grams

with glass Grammes grains
255.454 7

1118

87 Ohms resistance boxes

71 : 102 :: 87 :

87 1,9395
102 2,0086
comp 71 8,1487
125 Ohms 2.0968

3 | 195
65 1.8129
6.5 1.8129
1.6464
By galva. 7.9032
1500 ft.lbs. 3.1754

26.3 1,4200
775 2,8893
1.96 0,2923
Comp 32 8,4949
3.0965
1250 ft.lbs.

93
66.7
26.3

3,1754
3,0965
.0789

120

May 22

2-34 Temp air 80° F New mould paper

195 H, R
102 L, R on 87 Ohms

66.7° F

2-40 Started

80.
66.7
13.3
93°.3

71. L.R
2-44 71 LR
46 195 H R
3-6 Stopped
2-34
32
93° F 102 on 87

106 : 137 :: 87 :

87 1.9395

137 2.1367

comp 106 7.9747

112 Ohms 2.0509

(265

68.3 1.8346

68.3 1.8346

1.6464

7.9491

1840 ft lb 3.2647

May 22—1880

New moulded paper

1.127 grammes 7 grains

3-22 137 on 87 Ohms

3-25 Started 65°.9

264

82

65.9

161

63.

98.1

252

279

(531

3-28 265 H.R

106 L.R

3-41 97°.57 Stopped

22

19 137 L.R

1127.7
255 7
.972
.0022
1.844
1844
2.028 4
.056
2.084

97.5
65.9
31.6

2.08	0.3181
775	2.8893
31.6	1.4997
compl 9	8.7212
	3.2283

1700

3.2647
3.2283
1.0364

109

87 Ohms

(326
108.6

2.0350
2.0350
1.6464
8.0605
3.7779

6000

1124
235.5
868.5
.0022
17370
1737
1.91070
.056
1.967

1.967
30
775
comp 11

0.2938
1.4771
2.8893
8.9586
3.6188

4150 ft. lbs.

3.7779
3.6188
.1591

144

Calorimeter May 2
1124. Grammes New Mould Paper

157 on 87 Ohms

3-51 310 H.R
342
(652
326
~~678~~
air 82

3-54 68° F Started

155 on L.R

82
68
14
82
96

4-2 98° F

4.58
429
29

1444
1330
2⟌114
57

29 : 60 :: 57
60
3420

Candle burnt
118 grains a minute

31.5340
14624
2.0716

24
9
4⟌31
8
23

128 : 136 :: 87

92.4 Ohms

1.9395
2.1335
7.8928
1.9658

3⟌276
92

1.9638
1.9638
1.6464
8.0342
3.6082
4.5185
.9163

4050 ft lbs

8.13 per H.P.

Paper large mould

1444 ~~candles~~ weighed
4-29 P.M Started

276 H.R
24 candles Side.
136 L.R on 87 Ohms

9 candles edge.
128 - 27 L R
280 H.R
136 L.R on 87 Ohms

4-58 P.M. candles
weighed 1330 grains

263	87.9 Volts	10 Candles
247.8	82.6	
266	88.7 Volts	
250.2	83.4	11 12
268	89.6	
253.2	84.3	11.25 13 12.5
272	90.8	
256.2	85.4	13.25
275	91.9	
258.9	86.3	14
279.	93	
262.2	87.4	14 16.5 16.25
282	94.1.	
265.5	88.5	16.5 16.25
286	95.4	
269.7	89.9	19 19.25
290	96.8	
273.	91.	20
295	98.3	
277.5	92.5	20 24
300	100	
282.	94	29.

May 22 87.9 89 1.9440
$\bar{1}.9731$
82.6 1.9171

1.9481
$\bar{1}.9731$
1.9212 ✓

1.9526
$\bar{1}.9731$
1.9257 ✓

1.9582
$\bar{1}.9731$
1.9313 ✓

1.9631
$\bar{1}.9731$
1.9362 ✓

1.9683
$\bar{1}.9731$
1.9414 ✓

10

1.9739
$\bar{1}.9731$
1.9470 ✓

13- 19.

1.9797
$\bar{1}.9731$
1.9538 ✓

1.9860
$\bar{1}.9731$
1.9591 ✓

1.9929
$\bar{1}.9731$
1.9660 ✓

May 24 Motor

Cast iron machine
armature rewound six turns
0.61 Ohm

25 Volts on magnet

32.6 from armature

riven 1640 revs. per minute

32. Volts on magnet and
armature as motor
1480 revs

Fresh battery about 1% higher than
cells in use

148 : 143 :: 87

1,9395
2·1553
7,8297

84 ohms
1,9245

309
103

2,0128
2.0128
1.6464
8.0755

1181
255.454
925.546

5600
3.7475

H_2O vessel
20
945.5

945.5
.0022
775
338

2.9754
$\bar{3}$.3424
2.8893
1.5289

comp 9
9.0458
3.7818

6050

Galva. 5600
Calor. 6050

May 24
new mould carbon
81 Ohms in resistance

-35 1181 Grammes

2.89
330
619.
309.5 H.R

7453 on resistance 87 Ohms

1-43 67°27 Started

84
67.2
16.8
84
1008 102°

287
336

147.5 L.R
148

1-57
43
9

101°7 Stopped
67.2
338

1175
255.5
919.5
20
939.5 2.9729
.0022 3̄.3464
775 2.8893
39.5 1.5966
comp 13 8.8861 Calor.
4911 ft 3.6913

150 : 145 :: 87 1.9395
2.1614
1̄.8239
1.9238
83.9 Galon.
102 2.0086
2.0086
1.6464
8.0762
5490 ft lbs 3.7398

May 24
New mould carbon
1175 grammes
1-30 .145 on 87 Ohms

2-35 63.9° F Started

.84
63.9
20.1
84
104. 147.5 L.R
~~15~~
3.25
2.85
6.10
3.05 H.R
2-44 150 L.R

2-48 103.4° F
63.9
39.5

May 24

310 P.M Lamps No. 1085 Bart

240-2	8 candles	
230-2	6.5	
220-2	4 4	
210-2	3.25	
200-2	2.25	
240-2	7.25	
	8	8 7.75
	9	
	9, 8, 8, 8.75	
250-2	11	
260-2	15.5	16.75 16;
270-2	21.5	20
280-2	27	27.5

May 24
Lamp No. 1085 Bank

H.R.	L.R.
276	127
272	123
262	118
250	110
~~240~~ 228	102
220	~~8~~90
218	89

on lamp

On 87 Ohms

210	98
219	101
230	109
258	120
280	131

4-30 P.M.

May 24
1094

28 candles
267 H, R
150 L, R

270 30 candles

1094 May 28

15 candles

235 H. R

128 L. R on 87 Ohms

111 on

111 on

1156
255
895
20
915

96
72.25
23.75

775
915
.0022
comp 8

1. 3756
~~2~~. 8893
2. 9614
$\bar{3}$. 3424
9. 0969
3 .6656

4630

150 : 143 :: 187

1.9397
2.1553
7.8239
1.9189

83 ohms

1306
102

2.0086
2.0086
1.6464
8.0811
3.7447

5555 ft lbs

5-16	(71.25 72.25) ?
18	78.
19	81
20	84.5
21-30	88.25

85
72.25
12.75
85
97.25

85
71.2

288
325
613
306
150

H. R
L. R

5-24
5-16
8

96° F
143 on 87 ohms

1.

.885
.0022
775
28.9
Comp 9.

4800

2.9469
$\bar{3}$.3424
2.8893
1.4609
9.0458

3.6843

1120
255
865
20
885

4800 ft. lbs calor.
5500 " " galva

9404
6843
.0561

1.13%

May 24

1120 grammes total weight

5-34 | 69°.5 F Started

85
69.5
155
85.
100.5

149 L. R

305 H. R

5-43 | 98°.4 F
69.5
28.9

$n = \frac{375.36}{\sqrt{l}}$

$\sqrt{l} = \frac{375}{n}$

$\cdot\ l = \left(\frac{375}{N}\right)^2 \qquad n = 34.2$

2.5740
1.5338
1.0402
2
2.0804

121 inche
30 1/4 inches

2ft 6 1/4

May 25 1880
Test of large machine
see page 135 for magnet

$\frac{106}{5} = 21.2$ Volts on magnet

$\frac{45}{5} = 9$ Volts from armature turning 100 revolutions per minute Page 205

4' 10 1/2" large pulley
58.5 inches
20 inch dynamo pulley

$\frac{20}{58.5} \times 100$

3.3010
1.7672
1.5338

34.2 per minute

May 25

2·634 .4200
453 .6561
1.0761

11.9

2.22 ·3464
10·8 1·0334
24 1.3798

Small loop carbon round

From diagram

5 candles 2275 ft. lbs

10 candles 2750

2275 3.3560

475 2.6767

.6793

4.67.

10 candles 2750

20, candles 3650

2750

900

3.05

Large carbon 5 candles 2725

3400

2725 3.41354

675 2.8293

.6061

400

3400

4300

3400 3.5315

900 2.9542

.5573

360

Bast fibre p.159

Wood lamps

Tested by Jehl

R 83 Ohms cold

50.2 Ohms hot 15 candles

48.6 " 30 "

4670 ft. lbs 15 candles

5932 " " 30 "

4670 3.6693

1262 3.1004

.5689

3.7

20" machine

2 ohms in magnet

Very warm day

11.000 ft. lbs. p. 135

$$\text{Ft. lbs} = \frac{V^2\ 44.3}{R}$$

$$V^2 = R\,\frac{\text{ft lbs}}{44.3}$$

$$V = \sqrt{\frac{R\ \text{ft. lbs.}}{44.3}}$$

11000 22000 4.3424

R=2 0.

8.3536

$2\,)\,2.6960$

1.3480

40

22.2 Volts

5

111

222 10. to a Volts

$$\begin{array}{r} 22.2 \\ 1.7 \\ \hline 1554 \\ 222 \\ \hline 37.74 \end{array}$$

Armature 10 inches over all
9" of iron
8" of plates
1" end plates

When reduced in diameter
8" of plates only cut.

Page 197 also Large 20" machine

21.7 Volts on magnet

17.5 – 18 Volts from armature at 200

44 Volts on magnet
9 at 100

Magnet	Armature at 100 revs
18.5 Volts	8. 8.5
12.5	8.2
8.8	7.5

dropped to 2.5 immediately and to 1.5 in about 1/2 minute

	7.0
6.9	7.0 down
	6.0 up
5.5	6.4
	6.

.00336
9
.03024
2
.06048
649
.06697

Magnet 20" machine

32.5

9.2 Volts

9.1

75 Turns give 9 Volts
1.0 inches long ?

12 / 19 inches
1.58 0.1987
3.14 0.4969
0.6956
2500 3.3979
2.7023

504 r.p.m. to give surface speed of iron of 2500 feet per minute

.000666
504.
.00336 $\bar{3}.5263$

Constant to obtain inch of wire page 116

14.5433
14.513
303
.054
.0303
.0237

15.5703
15.4925
.0778
.054
.0238

15.673
15.6023
.0707
503
.0204

20.476
20.446
.030

18.078
17.9435
.1345
.0711
.0634

16.2165
16.1168
.0997
.0559
.0438

1852
173
.0122
.0559
.0437

.0634
.0438
.1072
.0536 averag 3/4

May 26

Meter Lawson's plates

(1)
14.5433
15.5703
30.1136
30.0055
2 .1081
.0541

14.513
15.4925
30.0055

(2)
15.673
20.476
36.149
36.0483
.1007 .0503

15.6023
20.446
36.0483

(3)
18.078
15.385
33.463
33.3207
.1423
.0711

17.9435
15.3772
33.3207

(4)
16.2165
15.1852
31.4017
31.2898
2 .1119
.0559

16.1168
15.173
31.2898

14.406

(5.)

14.41555
14.406
.0095

15.695
15.5793
.1157
.0626
.0531

24.990
53.1
$\frac{1}{470}$

4.3979
1.7251
2.6728

16.3147
2957
.0190

(6)

.0591
.0401

40.1
$\frac{1}{623}$

4.3979
1.6031
2.7948

357
331.81
25.19
.665
24.525

	24,990	4.3979
comp	24	8.6198
comp	19.5	8.7100
comp	66	8.2218

.89 Weber $\bar{1}.9495$

24.52
25.47
49.99
24.99

414.97
389.32
25.65
.18
25.47.

Lawson's plates

(5)

14.41555
15.695
30.1105
29.9853
1.1252
.0626

14.406
15.5793
29.9853

(6)

16.3147
18.8615
35.1762
.0580

16.2957
18.7623
35.0580

Large plates

2 | .1182
.0591

1	357		331.81	12.5
2	450.97	15	477.49	7.5
3	414.97	15	389.32	5
4	400.16	2.5	425.45	7

357
450.97
807.97

331.81
477.49
809.30
807.97
1.33
.665

414.97
400.16
815.13
814.77
.36
.18

389.32
425.45
814.77
407.7

Shunt

39.4
〃
39.5 — 1.5966
.114 — $\bar{1}.0569$
2.5397 — $\frac{1}{346}$

(576)

10
57.6 — 1.7604
.114 — $\bar{1}.0569$
.7035 — $\frac{1}{503}$

374 $\frac{1}{200}$ Shunt if cell no resistance

24.99 — 1.3977
.0237 — $\bar{2}.3747$
3.0230 — (1) $\frac{1}{1050}$

$.02\overline{)16.50}$
575

24.990 — 1.3977
.0536 — $\bar{2}.7292$
$\bar{2}.6685$

Ratio $\frac{1}{466}$ (374)

466
489
(955
477

page 108 $\frac{1}{489}$

Average 1 Lamp $\frac{1}{477}$

Each meter

Meter No 1 ~~and~~

	main line	branch
No 1 Shunts	.0208	11.5
(8) No 2 〃	.021	12. Ohms
(9) 3 〃	.021	4.2
(10) 4 〃	.0209	4.1
(11) 5 〃	.114	39.400
(12) 6 〃	.114	57.5

.114 — $\bar{1}.0569$
0208 — $\bar{2}.3181$
0.7388
12 — 1.0792
65.8 — 1.8180

Started 9-30 am
1 cell bichromate
Stopped 9-30 a.m

24 hours

2 candles

200 H.R

80 on lamp

93 on 87 Ohms

80 : 93 :: 87 :

1.9395

1.9685

8.0969

10.1 Ohms 2.0049

3(200

66.6

1.8235

1.8235

1.6464

7.9951

3.2885

1940

217.5 H.R

89 on lamp

101.5 on resistan

2.0054

1.9395

8.0506

99 ohms 1.9955

(217.5

72.5

1.8603

1.8603

1.6464

8.0045

3.3715

3.2885

2.6128

.6657

2350

1940

410

4.63

8 candles

239 H.R

102.7

112

95.2

239

79.6

2940

2350

590

3.99

2.0492

1.9395

7.9901

1.9788

1.9009

1.9009

1.6464

8.0212

3.4694

33715

2.7709

.6006

---

15 candles

259

116

121.5

91.1

259

8.6.3

3620

1.0845

1.9395

8.9355

1.9595

1.9360

1.9360

1.6464

8.0405

3.5589

20 candles

282

.87 Ohms

(282
94

1.9731
1.9731
1.6464
8.0605
3.6531
3.3589
.9912
.5677

4500
3620
980

3.7

16 candles

261

117

Fibre Lamp Bad spot in lamp

$\frac{R}{3} = \sqrt{\ }$

L R gild on lamp	H. R
7	30
11	47
12	51
16	62
19	71
28	97
32	113
100	275
139	335
94	250
85	228
76	198

On resistance 88 ohms

H.R	L.R Jehl
200	20
270	120
298	135

H.R	Candle Francis
280	6. candle

Bad spot in lamp

H.R. 9

Machines Exp

Fibre lamp

H.R	L.R.	Candles
270	R 123	
301	137	
179	L. 62	27" inches
190	65	30".5 inches
198	69	30".6
210	75	39".25
230	84	3.25 can
253	95	7 candles
282	110	17.25 candles
310	135	65".5 inches
285	120	34 Candles
290	123	26.5 C
272	115	18.75 C
275	114	20 C
282	117	22 C
286	122	25

Motor (May 27

445 revs 1/2 minute

5 lbs at 12 feet

$\frac{200}{1.5}$ Volts

~~[illegible]~~

242	95
112	35
128	41
132	45
165	59
185	68
~~250~~	+
265	110

Large machine

Magnet Armature

25. 5 Volts 8.

8 x 2

19.0 8.

15

15

75

15

125

44.3

375

500

500

5537.5

2768. ft lbs

2768) 33000 (12 for H.P.

2768

5320

page 272 strong current

387
338
725
362

$\frac{1}{362}$

Results meters

Cells 3 & 4 were used twice with same shunt and resistance and about the same current in main line and the average

page 108 $\frac{1}{489}$
212 $\frac{1}{466}$

average $\frac{1}{477}$ page 272

To calculate the current and the E.M.F.

Current found by Cu. or by H.R.G.
Resistance cell measured,
Current multiplied by resistance give E.M.F. = Volts used up in R, the dif. bet. this and Volts on line give E.M.F of cell

May 31 1880

Large machine page 203 100 r.p.m.

Volts on magnet Armature

10.8 7. Moderate day

4-40 12.5 7.5

Broke current

12.5 7.5

4-45 15.9 8

4-47 Broke the current

Two minute 7.3

4-49 15.9 7.7

Ball swinging wider

15.9 7.5

4-52

brought up to

8.

21 8.

Broke

5-56 7.7

one minute 8.1

short circuited 8.3

21

Volts on magnet
from

5-3

30 8.2

5-8

10.5 7.3

7.

7.

9.5 broke current 7.

6.6

5.7 5.7

4.9 ~~4.5~~

5.4

5.3

broke 10" 4.5

after " 4.7

4.6

all off 2.8

292 Turns one layer magnet

$$\begin{array}{r} 292 \\ 6 \\ \hline 1752 \end{array}$$

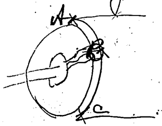
35 | 1 - 3

90 - 100

70 - 85

80 - 90

The wires connected on the large machine so that the current [illegible] generated in each could be separately tested:

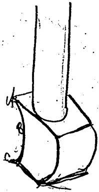


A strength 90-100 = Deflection.

B 70-85 = Deflection

C = 80 - 90 = D

This shows that the distribution of magnetic effect is very nearly the same throughout the whole field.



In ~~Small cast iron machine~~

2 feet of German silver wire 0".0265 in diam has a resistance of 0.17 Ohm

$\frac{0.17}{0.085}$ one foot

0".0265

26.5

551.5   2.7412

.085 $\bar{2}.9294$

1.67.06

46.7 Ohms

mill foot 46.7 in place of 127.3 as give by Jenkin

157   2.1959

.085 $\bar{2}.9294$

13.3   1.1253

Cast iron motor which never had any current on the magnets.

Machine run 1640 revs.

Magnets   Armature

0 Volts   0 Volts

~~5~~   ~~2~~

$\frac{7.5}{20} = 0.375$ $\frac{9.5}{20} = 0.475$

Current broken $\frac{1}{20} = .005$

$\frac{12.5}{20} = .6.25$ $\frac{18}{20} = .9$ Volts

$\frac{4.5}{20} = .022$

Current broken

$\frac{25}{20} = 1.25$ $\frac{46}{20} = 2.3$

Current broken $\frac{15}{20} = .75$

$\frac{45}{20} = 2.25$ $\frac{115}{20} = 5.75$

Current broken $\frac{50}{20} = 2.5$ ✓

On magnet Armature

$\frac{29}{5} = 5.8$ $\frac{76}{5} = 15.2$

Current broken $\frac{39}{5} = 7.8$

$\frac{43}{5} = 8.6$ $\frac{102}{5} = 20.4$

Current broken $\frac{48}{5} = 9.6$

$\frac{93}{5} = 18.6$ $\frac{157}{5} = 31.4$

Current broken

$\frac{51}{5} = 10.2$

$\frac{250}{5} = 50$ $\frac{217}{5} = 43.4$

Current broken $\frac{77}{5} = 15.4$

$\frac{300}{5} = 60$ $\frac{240}{5} = 48$

Current broken $\frac{83}{5} = 16$

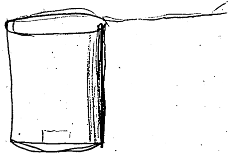
6.7 Ohms in magnet

after 2½ hours permanent

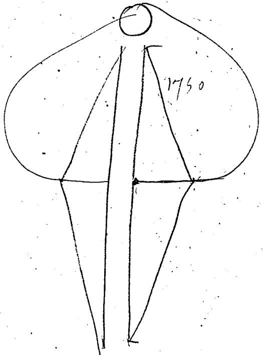
$\frac{39}{3} = 13$ Volts

$\frac{220}{3} = 73.3$ $\frac{145}{3} = 48.3$

Current broken $\frac{38}{3}$ Volts

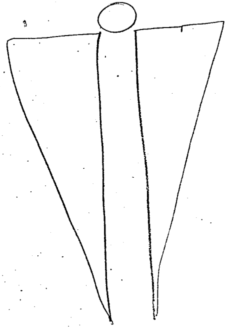


LRM.
June 1 1880

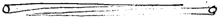


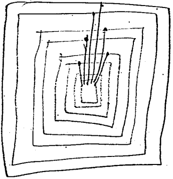
14.19

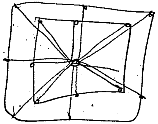
LRM
June 1, 1880.



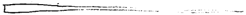
F.R.U.
June 1, 1880

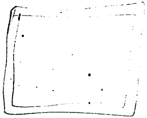


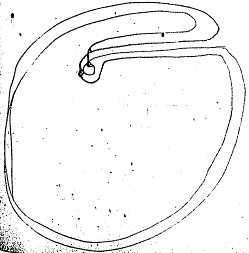




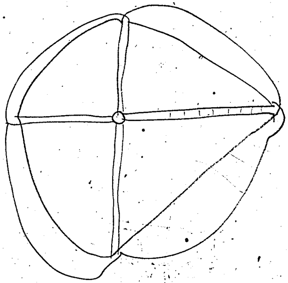
F.R.U.
June 1, 1880.







FRU
June 1 1880



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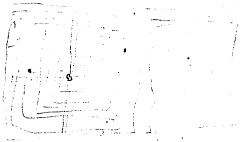
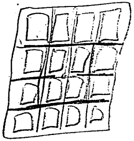
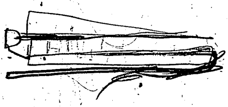
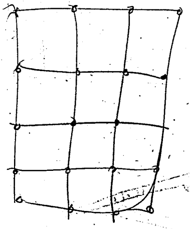
June 1, 1880.



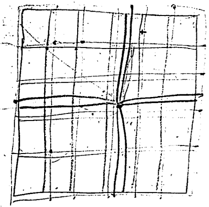


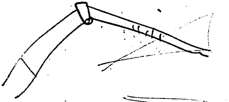
FRU June 1, 1880

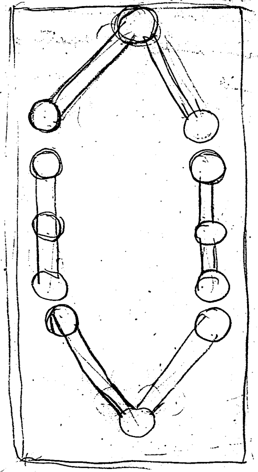




FRU June 1, 1880







Distribution June 4

Exs. tobe made and calcu.

Make artificial systems.

Required resistances of a system
100 Ohm boxes

Machines

Laws of winding in general terms

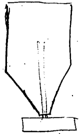
Law of magnets
Cast and wrought iron.
Whether the armature is magnetic at high speeds
Summaries of tests already made

Motors

Laws

Test with varying E. M. F and with varying resistance.

Power absorbing dynamometer water friction



Meters

Shunts with various current ~~to determine~~ how the law of the shunt varies. The surface of the copper plates should be varied. The contrary E.M.F. is probably a function of the intensity of the current per unit surface

Comparisons pot. galva. and Cu. cell.

Lamps

Full test of at least five lamps of a kind

Resistance candle power foot lbs. with surface and kind of lamps.

Bridge, substitution, pt. Cu. deposition & calor.

Galvanometer

The cells should be thoroughly cleaned every week, plates amalgamated &c. A cu. test should be regularly made each day to see if all is in order and to make allowances.

It has been proved that a given current ~~of a certain fixed strength~~ deposits a fixed amount of Cu under all the ~~varying~~ conditions of practice.

Two deposition cells should be used to check observations and all the current passed through them

Resistance boxes in line

How do you [illegible]

Lawson's Plates

Plate 7 whole currant

50.460
71.5265

(8)
56.430
55.205
111.635

56.375
55.175
111.550

.635
.550
.85

57.645

(9)
57.760
50.785
108.545

50.795
108.440

.42

.545
.440
.105
.52

(10)
55.670
55.815
111.485

55.665
55.715
111.380

.485
.380
.105
.52

(11)
57.505
55.435
112.940

57.430
55.455
112.885

.940
.885
.55
.27

12
56.915
56.515
113.430

56.840
56.530
113.370

430
370
60
30

71.5265
50.460.
21.0665
21

(8)
56.430
56.375
.055

(9)
57.760
57.645
.115
.52
.063

(10)
55.670
55.665
5
.52
.57

57.505
.430
.075
.27
.048

56.915
.840
075
030
045

Large Plates

1 356.1944 3

477.49
2 450.648 10
26.842
1.229
25.613

3 413.713 11

425.45
4 400.259 4
25.191
.399
24.792
25.613
50.405
25.202

356.194
450.648
806842
809.30
2.458
1.229

400.259
413.713
813.972
814.77
.798
.399

Meter

1	368	14.5
2	433	3.5
3	425	5.
4	386	5.

Meters

(8) 56.335

55.175 .020
111.510
111.550
.040

(9) 57.740
57.645

95
25
.070

50.650
108390
108,440 .050

(10) 55.595 .080
55.665
.060

55.755
111 340
111 3.80
40

(11) 55.385
55.455

70
15
.085

57.470
11 2.855
11 2.888
30

12 56.760
56.840

.080
.015
.065

56.580
113.340
11 370
.030

56.840 56760
56.580 530
.260 230

Shunts page 213

No. 8 .020 mg

No. 9 .070

10 .080

11 .085

12 .065

No (1) 368.98
356.194
12780
1.516
14.302

1.5.2

(2) 434.23
368.98
803.21
806,842
3,632
1,516

3.7

(3) 425.356
413.713
11.643
11,146
12.789

5.5

2

(4) 386.324
425.356
811 686
813 972
2,292
1.146

5

14.302
12.789
27.091

Systems 3000

June 1

2270
1.135
780
1915
780

388218

10 8

8

825
825

78

825

2

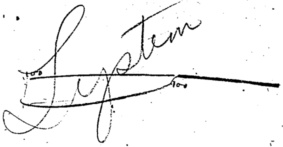
780 : 2270 :: x : 825
780
3050

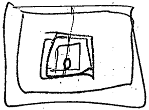
825

3050 : 1915 :: 825 : an
825
9575
3830
15320
3050) 1579875
15250
4487

510

440


System
100
100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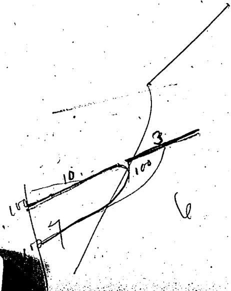
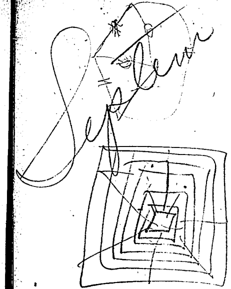
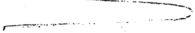
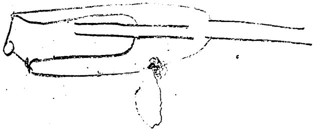



System





Meter

(8) 20) 2709x
1354

$\frac{1}{1354}$

(9) 70) 2709x
387

$\frac{1}{387}$

page 233

(10) 80) 2709x
338

$\frac{1}{338}$

(11) 85) 27091 (318
255
159
85
744

$\frac{1}{318}$

(12) $\frac{1}{415}$

65) 27091 (415
260
109
65
340

Shunt No. 5.

Ratio from resistance page 212

$\frac{1}{346}$

from Cu

small current $\frac{1}{470}$

heavy $\frac{1}{318}$

Shunt No. 6

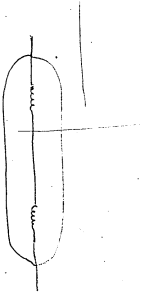
$\frac{1}{503}$ from resistance

small current $\frac{1}{623}$

heavy $\frac{1}{415}$.

60 tons
2240
60
134400 lbs
46
806400
5376
6)~~1156~~ 00
33)1926800
00 400
806400
5376
6)61524 00
33)110304 00

2)5520
60)2760
46



85000 5.9294..
67500 4.8293
1.1001

$1,25.

125000 5.0969
67500 4.8293
.2676

$1.85 at consumers

~~85~~

July 23 1880 F R Upton

Boilers & Chimney	21.000
Engines	21.000
Foundation	2.000
Iron Structure	3.500
Wood flooring	1.000
Water heaters & pumps	7.000
Iron floor and supports	6000
Faradic Machines	24.000
	95000
Conductors	30000.
	125000

6 per H.P.

1250.
6
7500
~~9~~ 9
67500

$1.85 investment per M annually

9 | .0004433
.000004925
5
.00024625
8
.001688

.003824
8
.030592

180
100
9
5

Depreciation & repairs

Boilers & Chimney	10%	$ 2100
Engines	3%	630
Foundation	1%	20
Iron Structure	2%	70
Wood flooring	5%	50
Water heaters & pumps	5%	350
Iron floors	2%	120
Faradic Machines	3%	720
		4060
~~Condu~~ Conductor		1000
		$ 5060

406000 5.6955
4.8293
4.8662 7.3 per M

506000 cts 5.7042
67500M 4.8293
.9749

9.4 cts per M at consumers

Taxes 2% 2500

250000 5.3979
67500 4.8293
.5686

3.7 cts at consumers

170000 5.2304
4.8293
.4011

2.5 at station

Labor
per day 2 Engineers $10
2 Wipers 3
$13

7500 lights
25 cu. ft
187500 M

3.1139
2.2729
.8410

6.9 at station

Continued Book 39 p 273

~~17 tons~~
15

75
3
225
15
1125
225
33,750

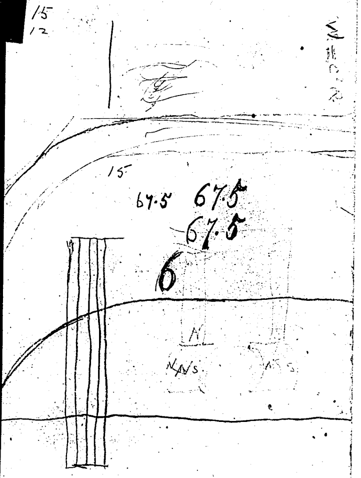
cars 18 tons
loco 12
pass 16
46

100 feet to mile

46
2,000
9,200,000 ft lbs

33) 9.200 (270
66
260
231
9,200,000

135 H.P.
67 H.P.



15
12
15
67.5
67.5
67.5
6
N
NNs
NNs